E73-11108
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SEVENTH BI-MONTHLY PROGRESS REPORT
UNIVERSITY OF ALASKA
ERTS PROJECT 110-1
September 30, 1973

A. TITLE OF INVESTIGATION:
Coordination and Establishment of Centralized Facilities and Services for the University of Alaska ERTS Survey of the Alaskan Environment

B. PRINCIPAL INVESTIGATOR/GSFC ID: Albert E. Belon/UN318

C. PROBLEMS IMPEDING INVESTIGATION:
The CDU-200 Digital Color Display Unit was delivered by the manufacturer, Interpretation Systems, Inc. (ISI) in mid-August and, following installation and testing, it became available for our use in mid-September. However, it does not yet meet the full technical specifications of the subcontract. In particular only one of its three channels is working satisfactorily. This deficiency presently prevents the reconstitution of false color images and makes the determination of digital multispectral signatures more time-consuming and cumbersome than it would be otherwise. The deficiency is caused by bad or noisy heads in the disc refresh memory. ISI has promised to develop a remedy for this as well as several other less major problems, and come back within two months to bring the CDU-200 to its full specifications and capabilities. Nevertheless, we have utilized the CDU-200 extensively since mid-September, and the one channel which is working has proved to be a great assistance in the interpretation of digital images (determination of multispectral signatures and color-coded display of classification maps).

The austere budget of the project, coupled with its heavy reporting requirements, continue to be a major constraint and source of concern.

D. PROGRESS REPORT:
1. Accomplishments during the reporting period
   a. Coordination and management of the U of A ERTS program

The principal investigator travelled to Washington D.C. and NASA/GSFC on September 20 and 21, 1973 in connection with another project and took this opportunity to discuss the progress, problems and results of the 12 U of A ERTS projects with the technical monitor, scientific monitor and ERTS project scientist. The schedule of U of A presentations at the October discipline panel review was also arranged tentatively.

The project coordinated a special session on the ERTS program of the University of Alaska at the 24th Alaska Science Conference "Climate of the Arctic" held during August 15-17, 1973. Six ERTS investigations were presented by projects 110-1, 3, 4, 8, 13 and 14. Three papers on "Remote Sensing in the Arctic" were also presented by investigators from NOAA/NESS and NASA/GSFC. Attendance at the meeting included a relatively large number of prominent national as well as international (Scandinavian, USSR) participants.

The second semi-annual reports of the 12 U of A ERTS projects were reviewed, edited and transmitted to NASA/GSFC.

During the months of August and September, approximately 360 new ERTS scenes of Alaska were received, catalogued, and transmitted to the various U of A ERTS investigators. Our Spring 1973 ERTS data map was completed (copy attached) and the Summer 1973 map was brought up-to-date. A catalog of available ERTS scenes of Alaska with 20% or less cloud cover from February through June 1973 was compiled. These Alaska ERTS data maps and catalogs are used extensively by U of A investigators as well as ERTS data users in government agencies and industry.

Sixteen duplicate digital tapes were returned to NASA/GSFC (ERTS scene nos. 1010-20331, two sets; 1028-20333, two sets; 1046-20332, two sets; 1081-20281; 1103-20513; 1103-20502; 1002-21315; 1038-21301; 1049-20505; 1066-20453; 1300-20460; and MSS and RBV test tapes). One set of duplicate tapes (ERTS scene 1081-20281) was transferred, with NASA's approval, to ERTS project 180 (P/I Ernest Lathram, U.S.G.S., Menlo Park, California).

Five data requests were submitted to NASA/NDPF by ERTS project 110-1, and many others on behalf of the other U of A ERTS projects. Few of these data have been received so far.

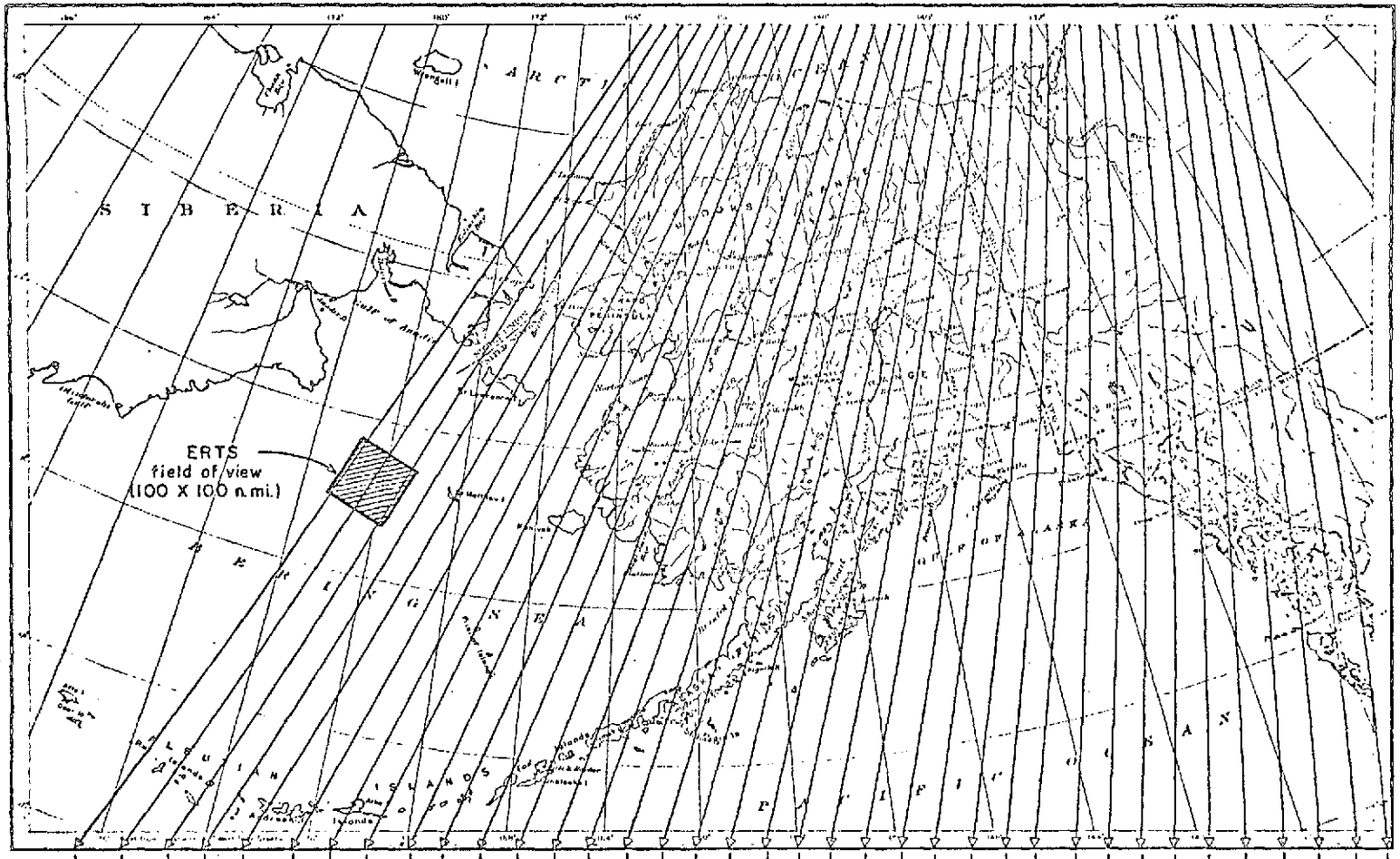
b. Establishment of data processing facilities

The photographic and optical data processing facilties have been established and operational for several months. They were described in the first and second semi-annual report on the project.

During the last three weeks in August and the first two weeks of September the CDU-200 (Digital Color Display Unit) was installed at the University of Alaska's Geophysical Institute by the manufacturer, Interpretation Systems, Inc. (ISI). As noted earlier in this report the system is only partially operational at this time and does not fully meet the specifications of the subcontract. However that part of the system which is working is proving to be a great assistance in the interpretation of digital ERTS images.

The CDU-200 consists of a number of major components as shown on the attached block diagram. CDU-format tapes, generated from the MSS digital tapes using the IBM 360-40 are input to the system using the Kennedy 9 track 800 BPI tape drive. Under control of the PDP 11/05 minicomputer, the Xebec tape controller and the write section of the disk interface transfer the information to the refresh disk. From the read section of the disk interface, again under control of the PDP 11/05 computer, the information can be processed either through the CD16 digital color encoder or through the AP-3 analog encoder.

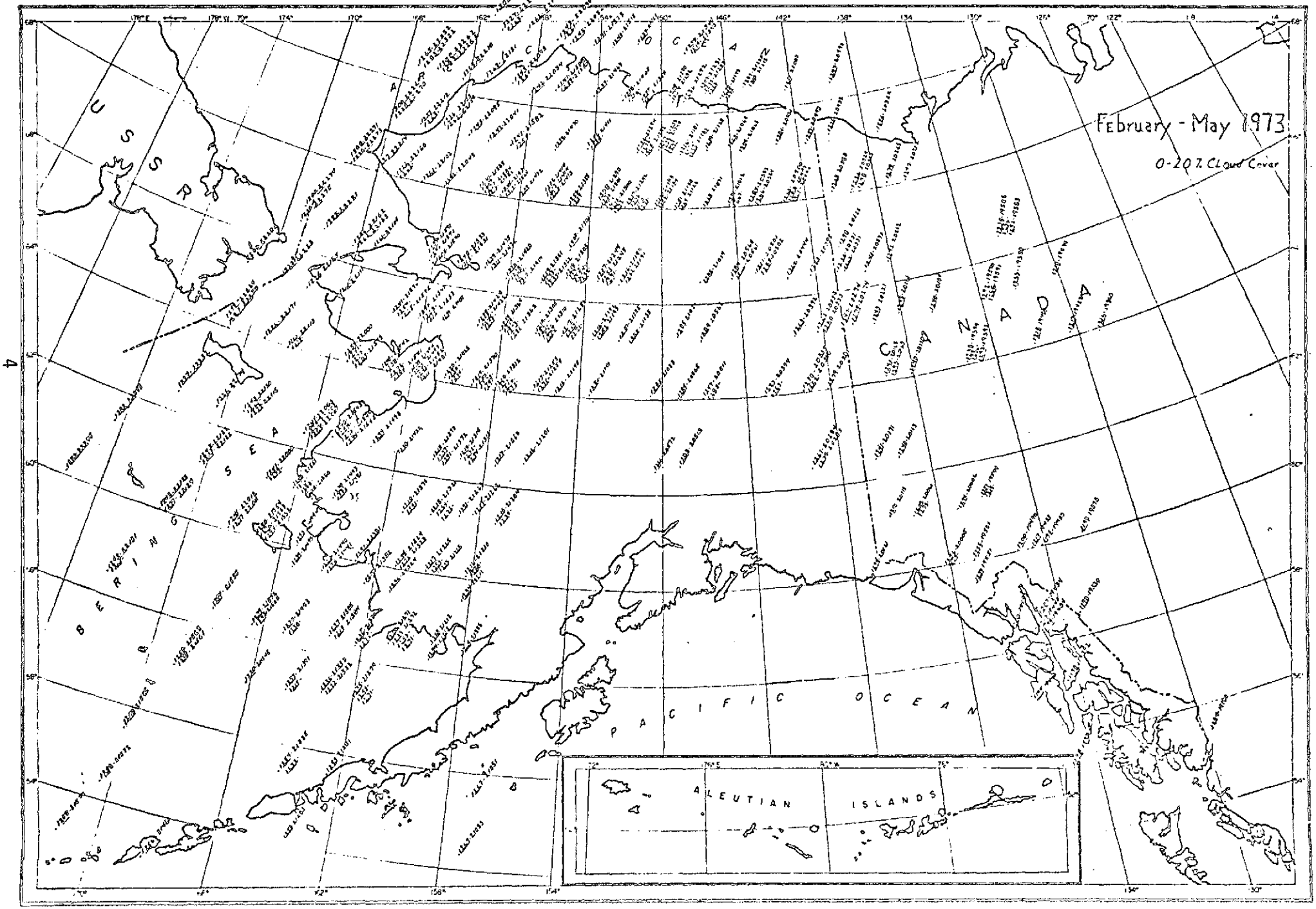
Four bits, or a maximum of 16 levels, are stored on the disk for each picel. When using the CD16 digital color encoder, a unique color is assigned to each of the 16 levels, and the image is displayed in a fashion very similar to a density sliced image. The CD-16 allows for any of its 8 primary colors and these eight colors intensified (resulting in 16 distinguishable colors) to be assigned to any level. Although only 16 levels can be displayed at one time, the system can display all 128 levels of MSS intensity by combining them in groups or by successive displays.

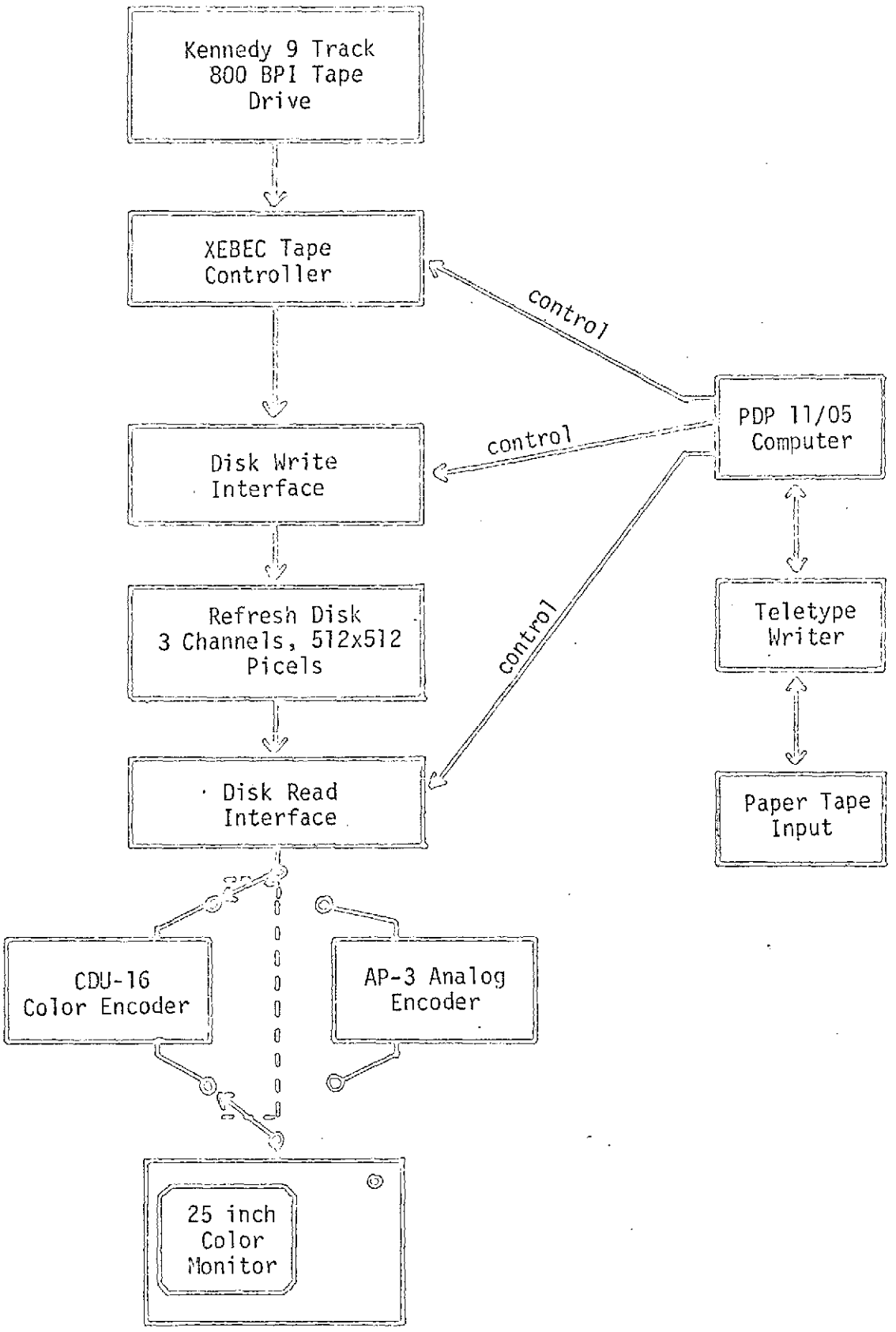


DATES IN JULY 73	14	13 31	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13 31	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14
DATES IN AUG. 73	1 19	18	17	16	15	14	13 31	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13 31	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19
DATES IN SEP. 73	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13	12 30	11 29	10 28	9 27	8 26	7 25	6 24
DATES IN OCT. 73	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13 31	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13 31	12 30
DATES IN NOV. 73	17	16	15	14	13	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17	16	15	14	13	12 30	11 29	10 28	9 27	8 26	7 25	6 24	5 23	4 22	3 21	2 20	1 19	18	17

ERTS-1 ORBITS FOR JULY TO NOVEMBER 1973

Prepared by : GEOPHYSICAL INSTITUTE, UNIVERSITY OF ALASKA


February - May 1973
0-20% Cloud Cover
U S S R
C A N A D A
B E R I N G S E A
P A C I F I C O C E A N
ALEUTIAN ISLANDS



Block diagram of Digital Color Display Unit (CDU-200)

Thus, using the CD-16 an investigator has several possible methods of operation. All levels may be assigned to black using the clear button. Colors may then be assigned to each level one at a time, thus giving the investigator a clear picture of what levels are present in any part of the test area. Or alternately the entire set of colors can be assigned using the "standard" button and levels within a test area can be determined merely by observation of the colors present. The investigator can instantly determine the effect of including certain levels in a classification as he can see what other parts of the scene have the same levels and thus would be included in the same classification as the test area. A multispectral signature ofa known feature in the test area can be obtained by color-coding the density level of that feature in each band successively displayed. The multispectral signatures of identified features then become the basis for a CDU-format classification tape prepared on the IBM 360/40 computer and displayed as a color-coded thematic image on the CDU-200 (See section on data interpretation techniques).

The AP-3 analog encoder assigns levels of brightness according to the sixteen levels for each picel stored on the disk. A disk channel may be displayed as any of the seven available colors which are red, green, blue, cyan, magenta, yellow or white. Each color has both a gain and a bias adjustment (similar to contrast and brightness on a normal TV) and with the adjustment of the gain either a positive or negative display may be obtained. When a disk channel is displayed on the white an excellent black and white image is obtained which is very useful for location of the scene and features within the scene. More than one disk channel can be displayed simultaneously, and when all three disk channels are available false color images can easily be created using either positive or negative displays of any three of the four MSS bands, with any band displayed as any color or even as a combination of colors. Using the one and a half disk channels presently available it has been demonstrated that this will be a powerful tool and will provide a very convenient means of image enhancement.

The CDU-200 is only partially completed at this time. Only one of the disk channels is working near correctly (it has some minor dropout problems). The second channel has only 256 x 256 resolution (half of the resolution specified) and has considerable dropout problems, due to some bad heads in the disc memory. Parts for the third disk channel are still missing but should be shipped to us within the next few days. Approximately 380 x 300 picels are present on the screen instead of the specified 512 x 512. Several other deficiencies and problems also exist. ISI has promised to correct these problems within the next two months. Every effort will be made to encourage ISI to expedite solutions to the remaining problems so that full use of the system can be made.

c. Development of ERTS Data Processing Techniques

In previous reports, principally the first and second semi-annual progress reports, we described the optical and photographic data processing techniques and the digital data processing techniques using computer printout outputs which have been developed and utilized by the U of A ERTS projects. These techniques were further improved during the last period as the need arose and our proficiency grew.

During the last two weeks of the reporting period, following installation of the CDU-200, we concentrated our activities on becoming proficient in the use of the CDU and its capabilities. The needs of the various U of A ERTS projects required that we place priority on the adaptation of our previous digital data processing techniques to their utilization on the CDU-200. In particular we have developed procedures and the necessary modification of computer programs to the determination of multispectral signatures on the CDU-200, to the generation and color-coded display of classification maps and, within the constraints of the two available CDU channels, to the generation of analog false color images using the AP-3 analog encoder.

A preliminary classification procedure was prepared for the use of the U of A ERTS investigators. Its description is attached.

2. Plans for the next reporting period

The project will work closely with the U of A ERTS investigators and coordinate with NASA the presentations of the status of each project which will be made on October 26 and 29 before the NASA Discipline Review Panels.

ERTS data will continue to be received, catalogued, mapped and transmitted to U of A investigators by the ERTS data library.

We will continue to press and work with the manufacturer of the CDU-200 for a prompt completion of the system and correction of its current deficiencies.

We will continue to develop computer programs for interpretation and display of ERTS digital data using the CDU-200. In particular we plan to develop a program for calculating and displaying interband ratio images in attempts to distinguish between different types of snow, sedimentation patterns and determination of multispectral signatures in and out of shadowed areas.

E. SIGNIFICANT RESULTS
None to be reported during period

F. PUBLICATIONS:
1) Published

Miller J. M. and A. E. Belon, A multidisciplinary survey for the management of Alaskan Resources utilizing ERTS imagery, Proceedings of Symposium on Significant Results Obtained from Earth Resources Technology Satellite - 1, Volume II, Summary of Results, pp. 39-49, NASA/GSFC, March 5-9, 1973.

Miller J. M. and A. E. Belon, earlier version of above paper, Volume I, Technical Presentations, pp. 999-1005, NASA/GSFC, March 5-9, 1973

Anderson J. H., L. Shapiro and A. E. Belon, Vegetative and Geologic Mapping of Western Seward Peninsula, Alaska, Based on ERTS-1 Imagery, Proceedings of Symposium of Significant Results Obtained from Earth Resources Technology Satellite - 1, Volume I, Technical Presentations, pp. 67-75, NASA/GSFC, March 5-9, 1973.

Miller J. M. and A. E. Belon, Alaska and the Super Eye, Alaska Magazine, vol. XXXIX, p. 34, September 1973.

2) In Press
Belon A. E. and J. M. Miller, Remote Sensing by Satellite - Applications to the Alaskan Environment and Resources, 1972/73 Annual Report, pp. 127-147, University of Alaska, Geophysical Institute, October 1973.

Miller J. M. and A. E. Belon, The University of Alaska ERTS Program, Proceedings of 24th Alaska Science Conference "Climate of the Arctic," University of Alaska Press, 1974.

G. RECOMMENDATIONS:
None

H. CHANGE IN STANDING ORDER:
None

I. IMAGE DESCRIPTOR FORMS:
Attached

J. ERTS DATA REQUESTS:

August 16, 1973	Data received
September 18, 1973	Not received
September 18, 1973	Not received
September 24, 1973	Not received
September 24, 1973	Not received

1. Investigator chooses a scene for analysis using ERTS photo products.

2. NASA MSS digital tape is obtained for the scene.

3. Investigator indicates to the programmer the area of interest on the scene.

4. Using the IBM 360-40 the 512 picel by 512 line area of interest is converted to a CDU format tape. Normally all four MSS bands are converted, each band being represented by one file on the CDU format tape.

5. The CDU-200 can present the information on the tape in a number of ways. Normally one of the bands is first displayed as a black and white image using the AP-3 analog encoder to provide orientation of the scene for the investigator. At this point areas of known classification may be identified and sketched in on the face of the color monitor using a grease pencil.

6. Using the AP-3 analog encoder several false color images can be presented which may give some insight into the spectral signatures present. Normally, however, the task of determining for each of the MSS bands the actual intensity levels for each classification is the next logical step. The CD-16 allows for the coding of up to 16 levels by displaying 16 unique colors, one for each bit combination for the 4 bits of information stored on the disk.

7. The first step in determining the actual intensity levels is to read the 4 high-order bits from each 8 bit byte on the tape onto the disk using the manufacturer provided software. For each classification or test area the value of the 4 high-order bits can be determined by observation of the image.

8. Next the 4 low-order bits are read in for the same band and using the same technique the colors in each classification or test area are determined. The levels obtained in step 7 are multiplied by 16 and then added to the levels obtained in this step. Thus the actual intensity level on the basis of 0 to 127 can be determined for any area on the scene.

9. Steps 7 and 8 are repeated for each band and for each classification desired. The result is a classification table such as the example given here.

Example of Classification Table

Feature Classified	Levels Present			
	Band 4	Band 5	Band 6	Band 7
Clear Water	16-18	9-10	6- 8	1- 3
Spruce	18-19	11-12	15-19	8-10
Birch	18-20	11-12	25-30	14-18
Grass	20-22	14-18	31-42	18-24

10. The classification table resulting is then used as the basis for a subroutine for the ERTS classification program on the IBM 360-40. The 4 band CDU format tape is then used as input for the classification program and another CDU format tape is generated with just one file, where each classification is assigned a specific level.

11. The tape which is the result of step 10 is then displayed on the CDU-200, and each classification can be presented as a distinct color. Photography or other processes can then be used to prepare a map showing the areas of the various classifications.

Advantages of using the CDU-200 over previous methods are many. The extremely cumbersome computer printouts previously used to display a scene are completely avoided, along with the high cost associated with these. Land features are much easier to recognize on the CDU-200 than on the print-outs. Determination of actual levels is straightforward as explained in steps 7 and 8 and in many special cases can be done in a single step. By switching of the colors assigned to the levels (one color can be assigned to any number of levels) the investigator gets an instant insight into the probable result of a classification assignment as all areas of the scene affected can be spotted instantly. The final result, that is, a color coded classification presentation is greatly superior to a digital printout.

ERTS IMAGE DESCRIPTOR FORM

(See Instructions on Back)

NDPF USE ONLY
D
N
ID

DATE September 30, 1973

PRINCIPAL INVESTIGATOR Albert E. Belon

GSFC U318

ORGANIZATION Geophysical Institute, University of Alaska

PRODUCT ID (INCLUDE BAND AND PRODUCT)	FREQUENTLY USED DESCRIPTORS*			DESCRIPTORS
	glaciers	mtns	snow	
1387-20275	x	x	x	rivers
1387-20281	x	x	x	ocean, rivers, islands
1389-20291	x	x	x	ocean, islands,
1389-20394	x	x	x	islands, ocean
1390-20450	x	x	x	city
1390-20452	x	x	x	lakes, ocean

*FOR DESCRIPTORS WHICH WILL OCCUR FREQUENTLY, WRITE THE DESCRIPTOR TERMS IN THESE COLUMN HEADING SPACES NOW AND USE A CHECK (✓) MARK IN THE APPROPRIATE PRODUCT ID LINES. (FOR OTHER DESCRIPTORS, WRITE THE TERM UNDER THE DESCRIPTORS COLUMN).

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GSFC 37-2 (7/72)